Butterflies and landscape connectivity

Do effects depend on species traits and conservation value?

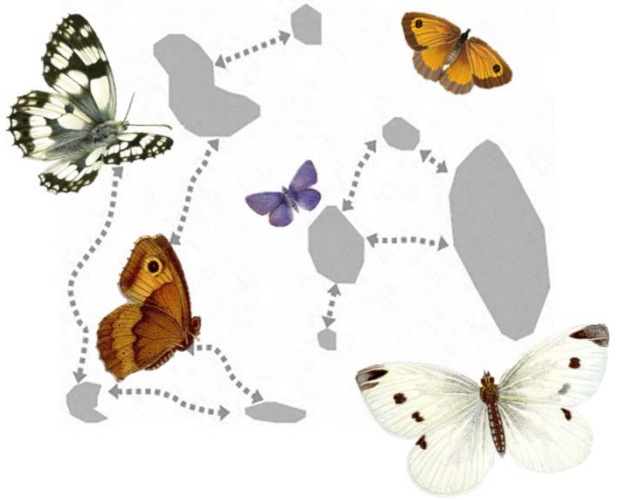
Anne Villemey

I. van Halder, A. Ouin, L. Barbaro, J. Chenot,

P. Tessier, F. Calatayud, H. Martin, P. Roche, F. Archaux

ICCB, ECCB

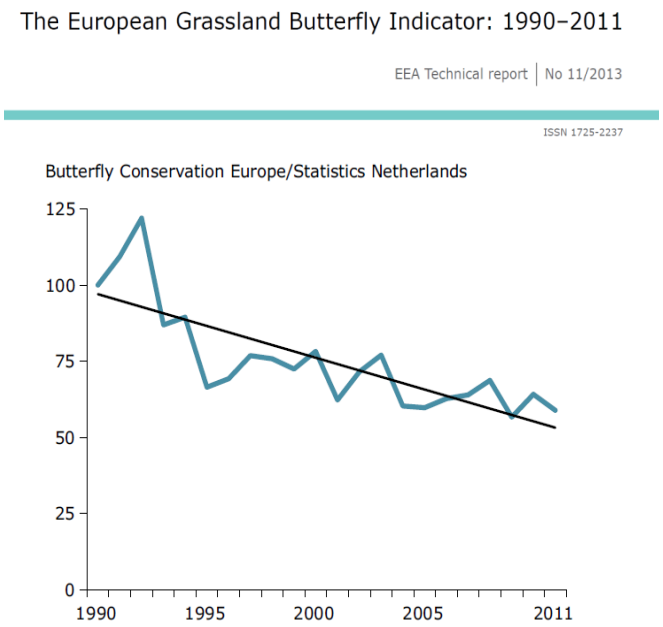
Montpellier, August, 2015



Context

BUTTERFLIES IN A CHANGING WORLD

Declining, especially in farmland



Context

BUTTERFLIES IN A CHANGING WORLD

Declining, especially in farmland

Sensitive to habitat loss

Context

BUTTERFLIES IN A CHANGING WORLD

Declining, especially in farmland

Sensitive to habitat loss

None or trait-dependent negative effect of habitat connectivity

Journal of Biogeography, 30, 889–900

How does landscape context contribute to effects of habitat fragmentation on diversity and population density of butterflies?

Jochen Krauss*, Ingolf Steffan-Dewenter and Teja Tscharntke *Agroecology, University of Göttingen, Waldweg 26, Göttingen, Germany*

Landscape Ecol (2013) 28:1283–1292
DOI 10.1007/s10980-013-9864-2

RESEARCH ARTICLE

Trait-dependent responses of flower-visiting insects to distance to semi-natural grasslands and landscape heterogeneity

Johan Ekroos · Maj Rundlöf · Henrik G. Smith

Context

HABITAT CONNECTIVITY

Lot of metrics

No consensus on the “best metric”

Depends on population functioning

REVIEWS REVIEWS REVIEWS Front Ecol Environ 2004; 2(10): 529–536

529

A comparison-shopper’s guide to connectivity metrics

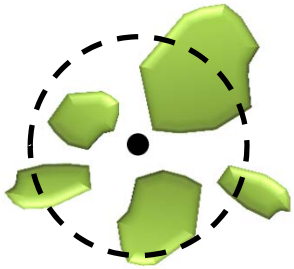
Justin M Calabrese and William F Fagan

Landscape Ecol (2008) 23:879–890
DOI 10.1007/s10980-008-9245-4

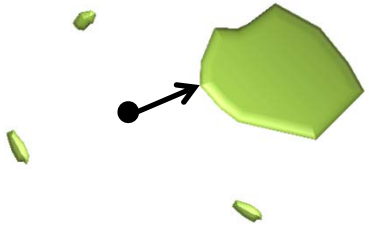
Connectivity measures: a review

Pavel Kindlmann · Francoise Burel

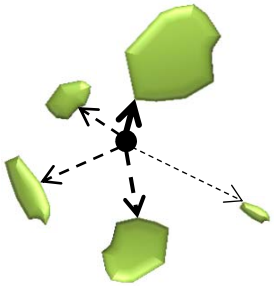
Proportion in a radius



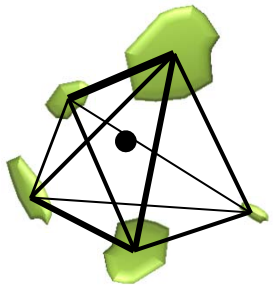
Distance to the nearest patch



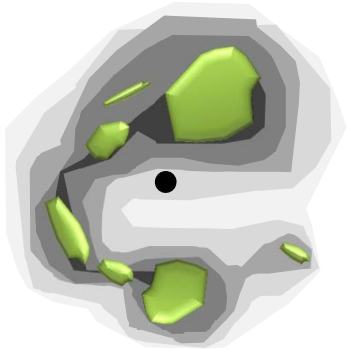
Hanski’s index



Graph theory



Circuit theory



Context

HABITATS IN AGRICULTURAL CONTEXT

Grassland patches

- main habitat

Linear elements

- alike grasslands
- non-negligible amount

Woodlands

- complementary / supplementary resources?

Most studies focused on

- Extremely fragmented landscapes
- High-conservation-value habitats

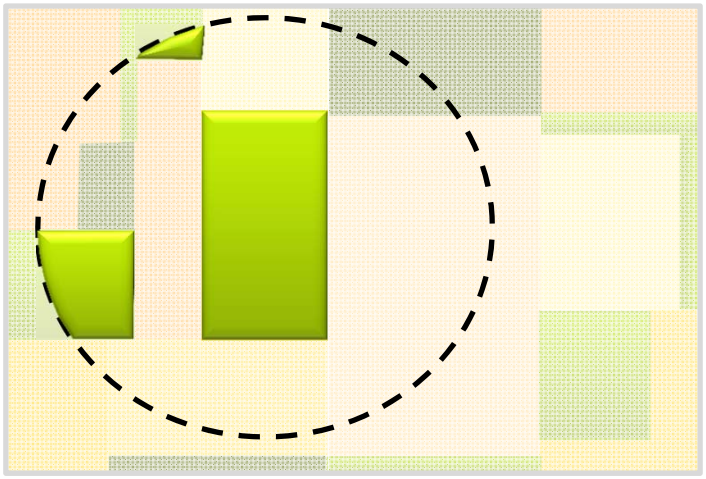
They did not consider

- Linear elements
- Woodlands

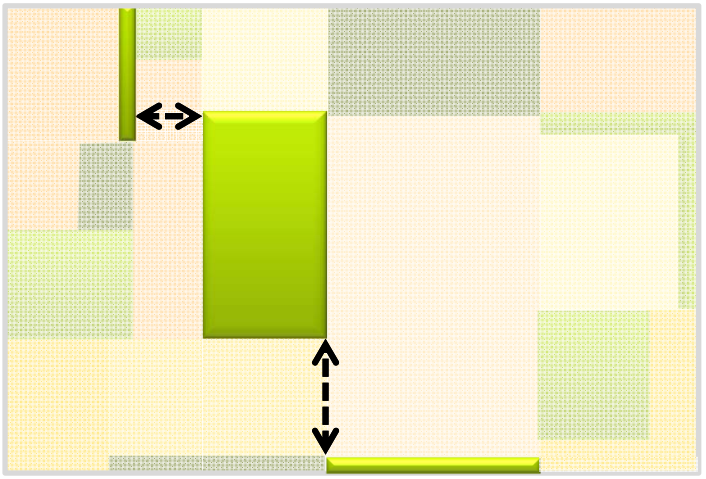
Context

HYPOTHESES

The best connectivity index in grassland patches is the **amount** of surrounding semi-natural grasslands



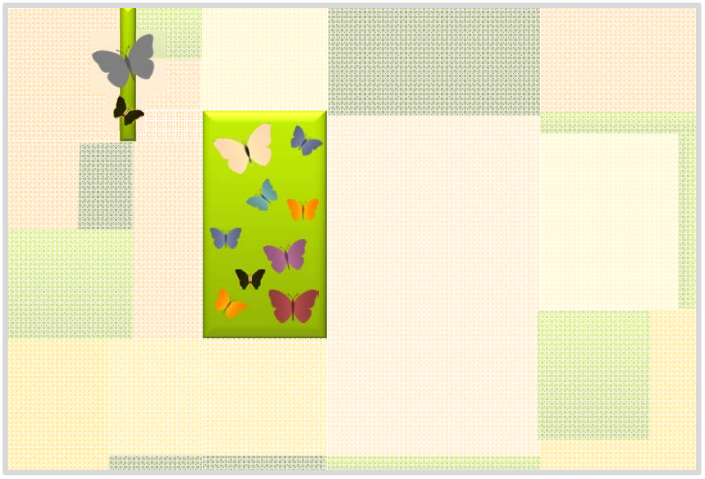
In linear elements, connectivity metrics including **distance** to grasslands better fit butterfly patterns



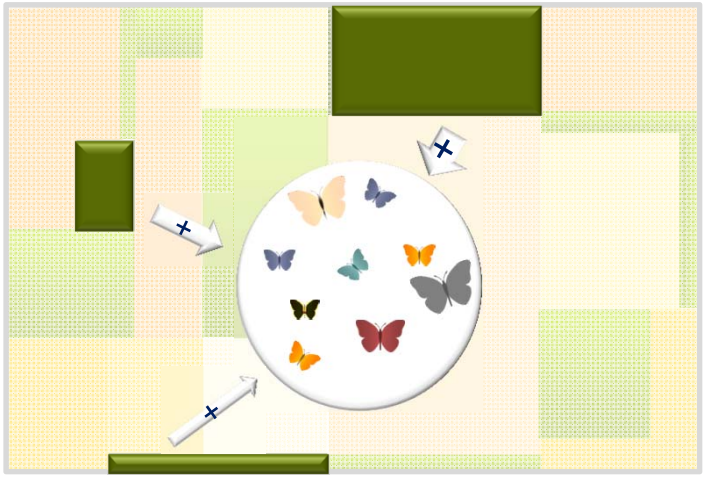
Context

HYPOTHESES

Communities are of lower conservation value in linear elements compared to grassland patches



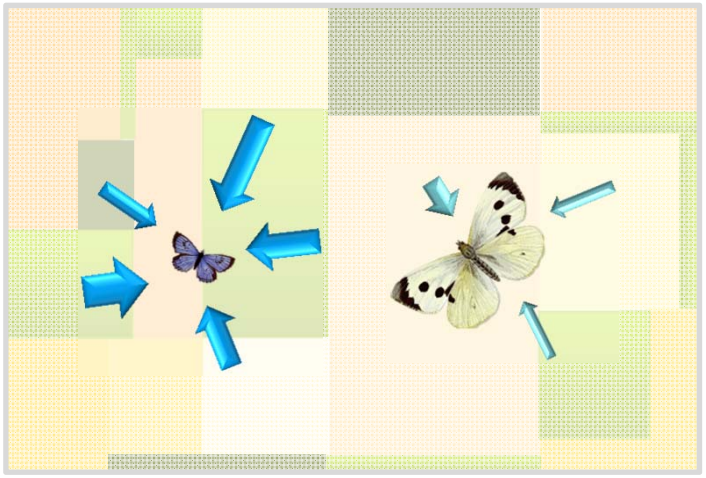
Woodlands have a additional positive effect



Context

HYPOTHESES

Grassland specialist and sedentary species are more strongly affected by landscape than generalist and mobile ones



Methods

SAMPLING DESIGN

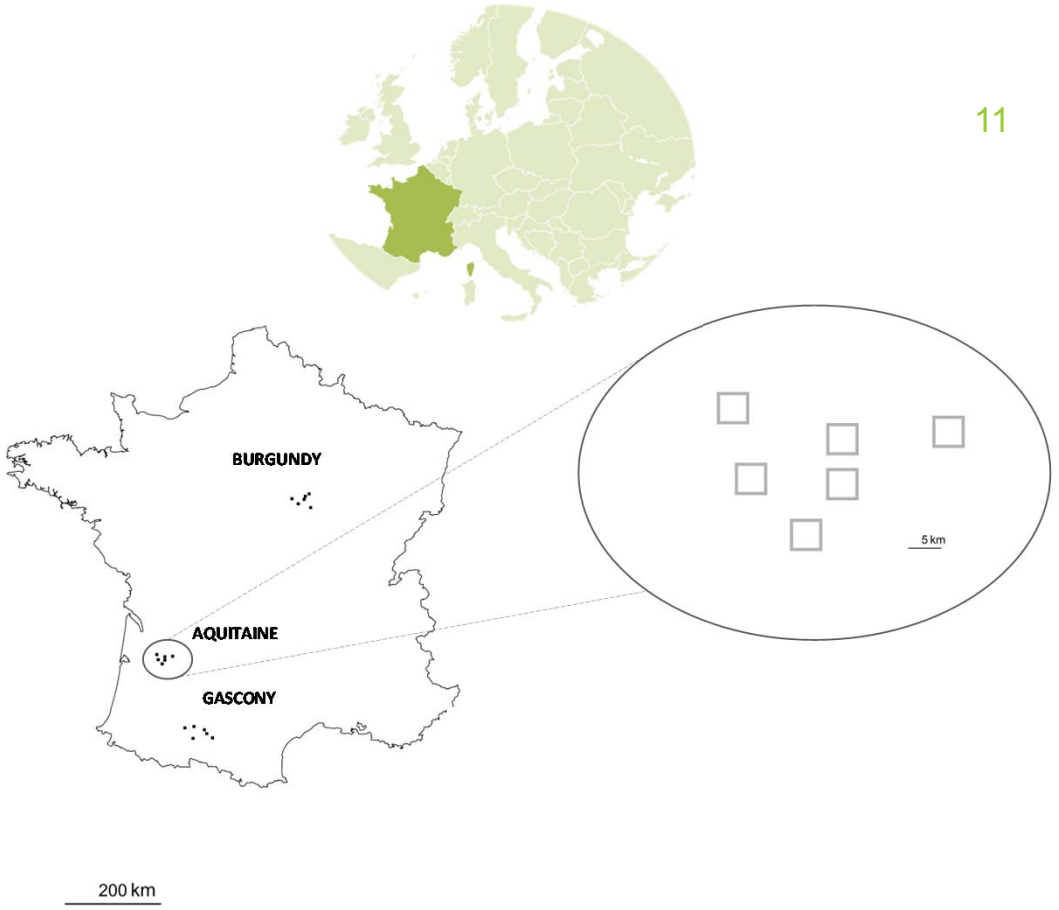
3 regions

Methods

SAMPLING DESIGN

3 regions

6 replications / region



Methods

SAMPLING DESIGN

3 regions

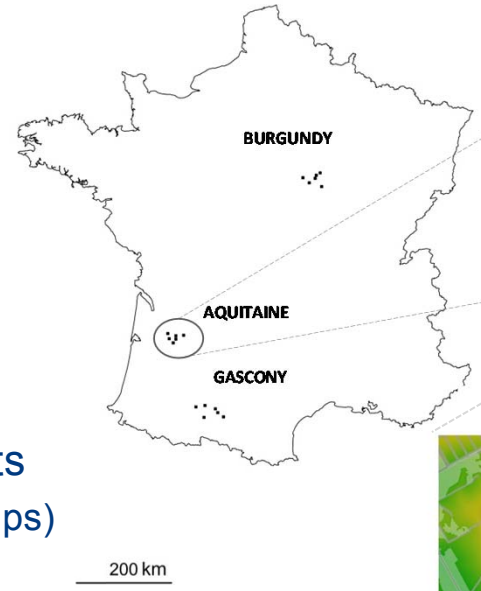
6 replications / region

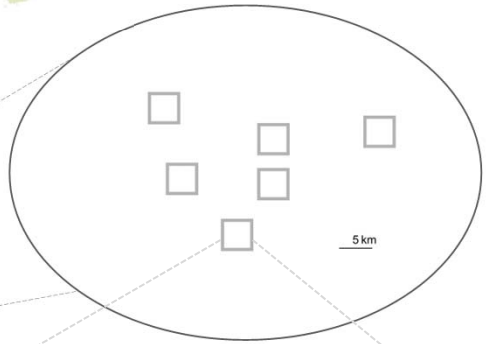
In each landscape:

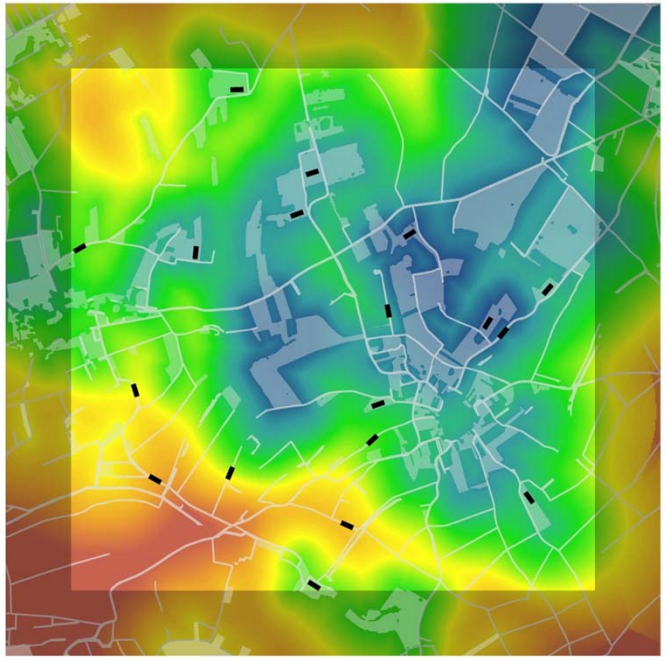
- 8 grasslands
- 8 grassy linear elements

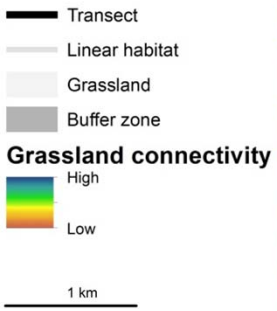
(half road verges, half grass strips)
along a grassland
connectivity gradient

→ **286** sampled sites









Methods

FIELD WORK

Transect 5 x 100 m

Butterflies recorded 3 times

(6624 ind. 78 sp.)

Local quality

Methods

FIELD WORK

Transect 5 x 100 m

Butterflies recorded 3 times

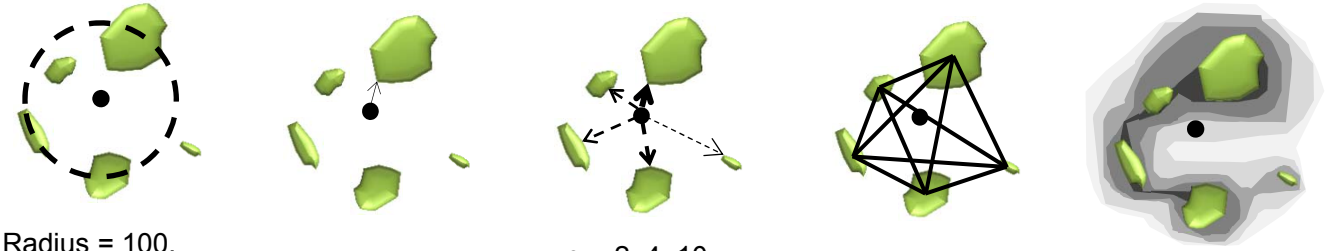
(6624 ind. 78 sp.)

Local quality

CONNECTIVITY METRICS

Grassy linear elements

Grassland patches, woodlands



Radius = 100, 250, 500 m

α = 2, 4, 10

METHODS

STATISTICS

Linear mixed models

Datasets

Grasslands and linear elements separately

Response variables

Community conservation value

Species richness by group

- grassland specialization (2 grps)
- dispersal capacity (2 grps)

$$y = XB + ZU + E$$

Random effects

Landscapes nested in regions

Explanatory variables

Connectivity metrics

- grasslands
- woodlands
- linear elements

Habitat quality

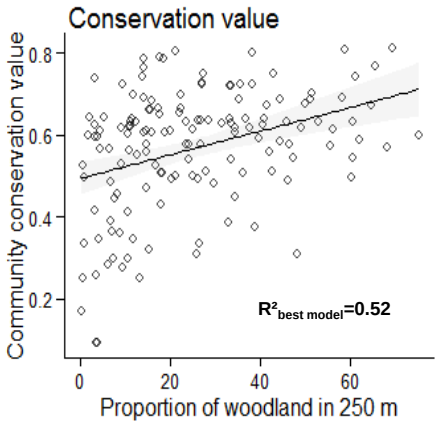
- nectar resources
- host plant diversity
- vegetation height
- nutrient level

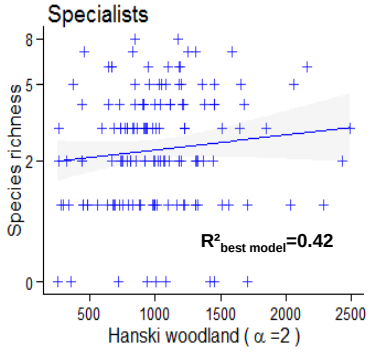
Results

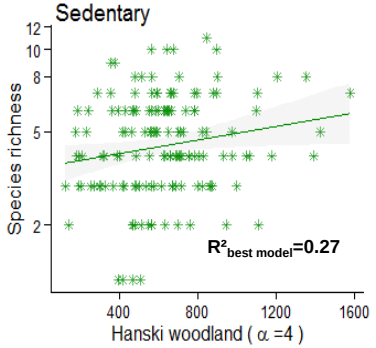
GRASSLANDS

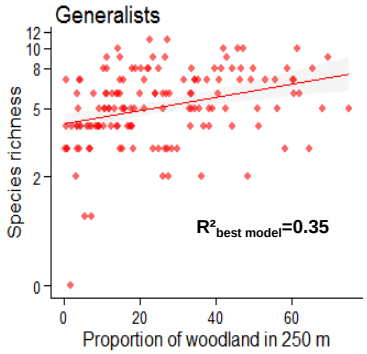
No effect of grassland connectivity

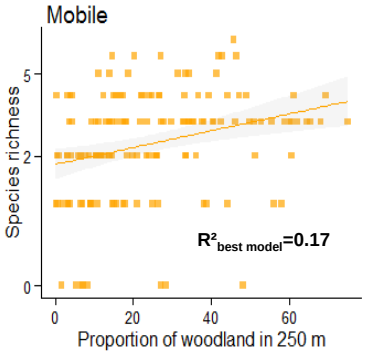
Positive effect of woodland in vicinity (% 250 m or Hanski)









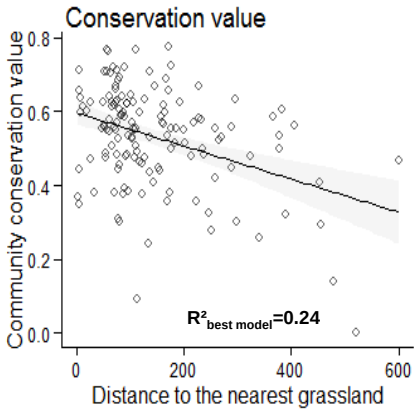


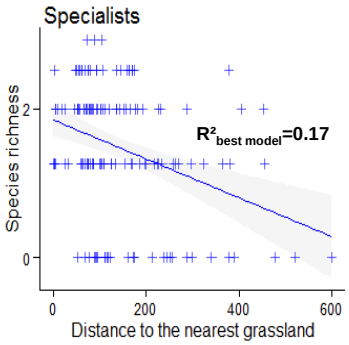
Results

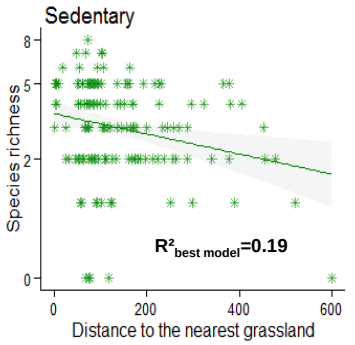
LINEAR ELEMENTS

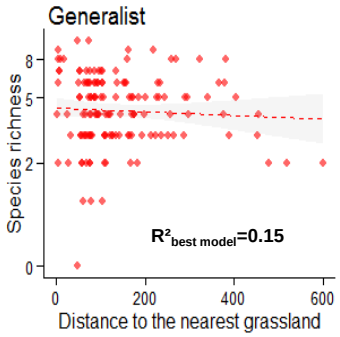
Conservation value and species richness of specialist and sedentary **decrease with distance to the nearest grassland patch**

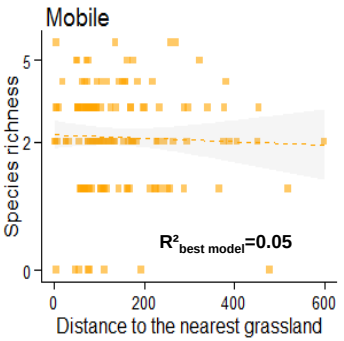
No effect of woodland connectivity







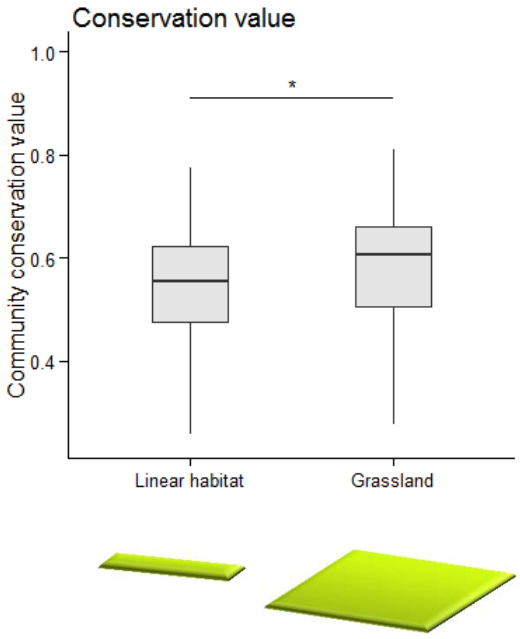


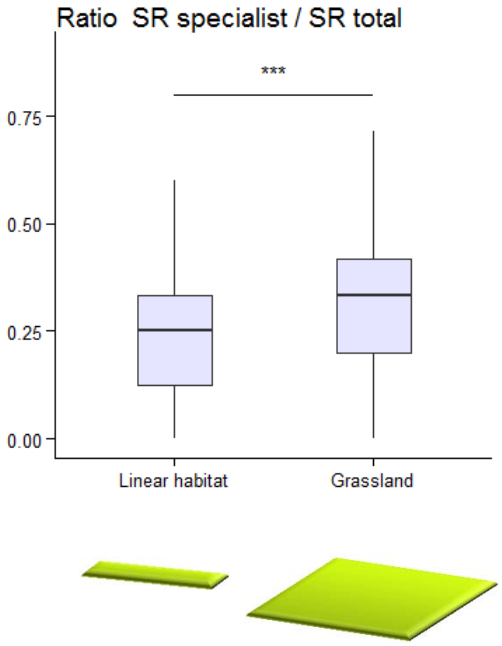


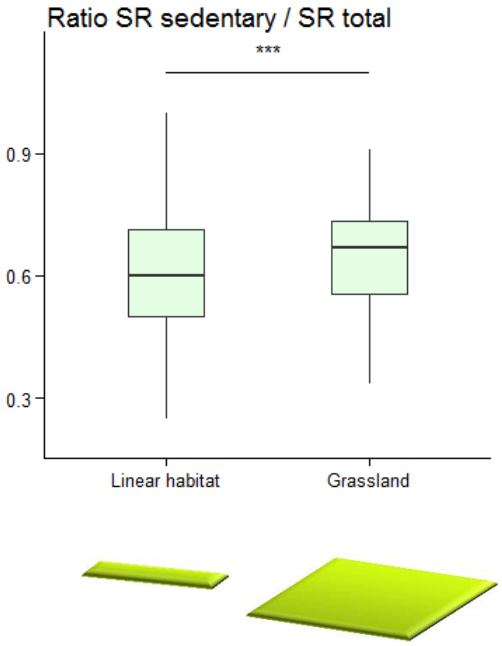
Results

GRASSLANDS VS LINEAR ELEMENTS

Linear habitats contains communities of **lower conservation value with fewer specialist and sedentary species** than in grasslands





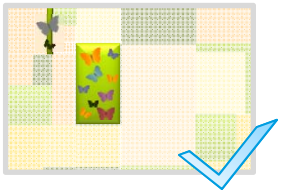


Discussion

RESULTS

Communities impoverished in linear elements

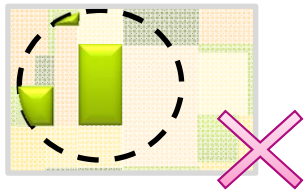
Lower quality (resources, edge effect), carrying capacity



In grasslands

No effect of grassland connectivity

→ Contexts not enough fragmented (17% grassland)



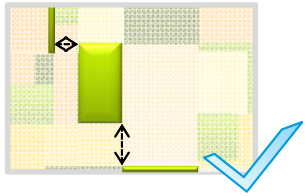
% woodland positive

→ Complementation/supplementation, functional spillover?

In linear habitats

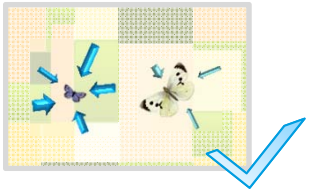
Decreased diversity with distance to grassland

→ Source-sink or island-mainland?



Species traits

Specialists and sedentary species more impacted



irstea

Discussion

CONSERVATION IMPLICATIONS

Linear elements

Not sufficient to preserve butterfly communities

Woodlands

Positive effect even on grassland specialists

Species of conservation concern most impacted

Homogenization of communities

Connectivity metrics

Using multiple metrics help to understand population/community functioning

Discussion

CONSERVATION IMPLICATIONS

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→ Mosaic of grasslands and woodlands is more effective than habitat connectivity to conserve butterflies in French farmland

Thanks for your attention!





Questions?

Biological Conservation 191 (2015) 206–215

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/bioc

Mosaic of grasslands and woodlands is more effective than habitat connectivity to conserve butterflies in French farmland

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Acknowledgments

M-L. Benot
A. Chemin
R. Chevalier
E. Corcket
J. Dudit
I. Lahlou
G. Lamontagne
B. Lamouroux
Y. Paillet
M. Tessier
R. Rudelle
J. Willm

Funding

Program DIVA 3, LEVANA project, French Ministry of the Environment

ICCB ECCB 2015